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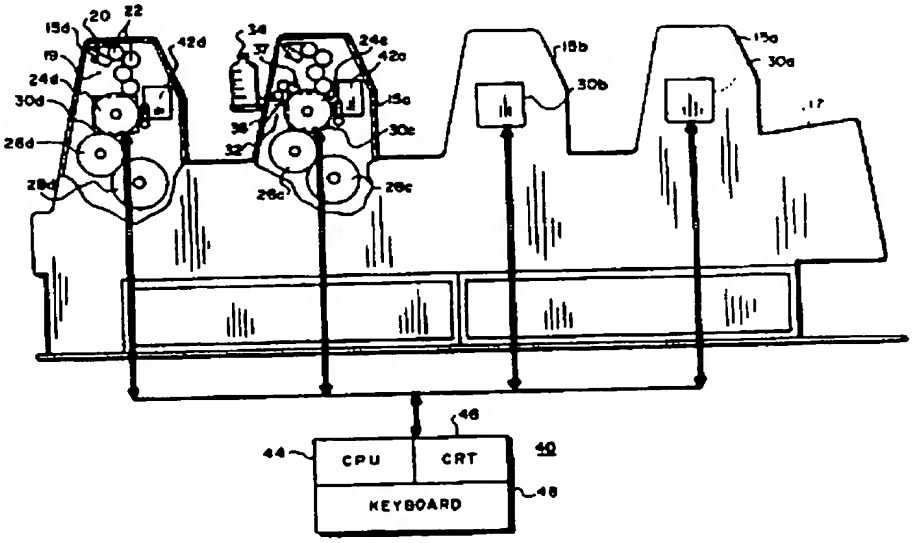
(54) Title: IMPROVED PRINTING APPARATUS AND METHOD

(57) Abstract

Printing apparatus has at least one print station including a blanket cylinder in rolling contact with an impression cylinder, a print cylinder for supporting a lithographic plate, the plate cylinder being in rolling contact with the blanket cylinder, at least one discharge source for applying an image to a plate supported by the plate cylinder, and a motor for moving the energy source relative to the plate cylinder so that when the plate cylinder is rotated, the discharge source scans a raster on the surface of the plate supported by the plate cylinder. The apparatus may be configured as an in-line or central-impression type press. A controller responsive to picture signals representing an original document repeatedly actuates each discharge source momentarily during the scan thereof so that the discharge source forms on the plate surface an image comprised of dots corresponding to the original document. The controller includes a dot-position look-up table for storing the x and y coordinates of substantially all dot positions on the plate and is arranged to actuate each energy source to form image dots at selected ones of the dot positions when said picture signals are present. The apparatus also includes provision for regulating the ink applied to the plate at each print station.



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AMENDED CLAIMS

[received by the International Bureau on 6 July 1992 (06.07.92);
original claims 2, 6-8, 39-41 and 68 cancelled, original claims 1, 3, 4 and 25 amended;
newly filed claims renumbered as claims 1-86 (16 pages)]

1. Printing apparatus comprising:
   a. at least one print station, each station including a plate cylinder for supporting a printing plate, at least one discharge source for applying an image to the plate and means for moving each discharge source relative to the plate cylinder so that when the plate cylinder is rotated, the at least one discharge source scans a raster on the surface of the plate;
   b. means for rotating each cylinder, and
   c. control means responsive to electronic signals representing an original document for repeatedly actuating the discharge source momentarily during the scan thereof so that said discharge source forms on the plate surface an image comprised of dots corresponding to the original document, said control means including:
      i. a dot position look-up table for storing the x and y coordinates corresponding to substantially all dot positions on the plate:
      ii. means for actuating said discharge source to form image dots at selected ones of said dot positions when said electronic signals are present; and
      iii. means for offsetting, with respect to said x and y coordinates, the action of the discharge-source actuation means to correct imaging errors.

2. The apparatus defined in claim 1 wherein the controller further includes means for altering the length of the scan to adjust the circumferential size of the image.

3. The apparatus defined in claim 1 comprising a plurality of print stations, wherein
   a. each print station further includes sensing means, coupled to the plate cylinder, for generating a signal indicative of the angular position of the plate

cylinder,; and

b. the apparatus further includes a press controller, coupled to all of the sensing means, for receiving the angular-position signals and coordinating all of the cylinder-rotation means to maintain angular registration among the plate cylinders.

4. The apparatus defined in claim 3 further comprising means for sequentially transferring a recording medium among print stations.

5. The apparatus defined in claim 1 wherein each discharge source is a spark discharge electrode.

6. The apparatus defined in claim 1 wherein each discharge source is a plasma jet.

7. The apparatus defined in claim 1 wherein each discharge source is a laser.

8. The apparatus defined in claim 1 wherein each discharge source is a non-laser source of electromagnetic radiation.

9. The apparatus defined in claim 1 wherein each discharge source is an ink jet.

10. The apparatus defined in claim 1 and further including:

a. ink-regulating means responsive to ink-control signals at each print station for regulating the amount of ink applied to the plate on the plate cylinder of that station; and

b. ink-control means for providing ink-control signals to said regulating means, said ink-control means counting the number of image dots to be formed by each print station on selected portions of said plate and controlling said ink-regulating means at that station

based on the number of dots to be printed by that print station on said selected plate portions.

11. The printing apparatus defined in claim 10 and further including:

a. color densitometer means for sensing the colors in the printed matter printed by the printing apparatus;
b. means for comparing the densitometer means readings with the dot count for each print station to produce a color correction signal for that station; and
c. means for applying said correction signal to said control means to adjust the amount of ink applied by said ink-regulating means.

12. The apparatus defined in claim 10 wherein each ink-regulating means at each print station include a plurality of electrically actuated ink-regulating keys spaced across the apparatus for regulating the amounts of ink applied to different circumferential zones of the plate on the plate cylinder at that station, the setting of each key at each station being determined, at least in part, by the number of image dots to be printed in the corresponding zone of the printing plate at that printing station.

13. The apparatus defined in claim 12 and further including means for applying color-correction signals to said ink-control means to change the ink-control signals to said regulating keys so that the settings of said keys may be offset from their positions determined by said image dot counts.

14. The apparatus defined in claim 13 and further including color densitometer means for sensing the colors in the printed matter printed by the printing apparatus.

15. The apparatus defined in claim 14 wherein each ink-regulating means at each print station includes a plurality of

electrically actuated ink regulators spaced across the apparatus for regulating the amounts of ink applied to different circumferential zones of the plate on the plate cylinder at that station, the setting of each ink regulator at each station being determined by comparison of the densitometer means readings with a predetermined density level.

16. The printing apparatus defined in claim 1 wherein the apparatus has at least two said print stations for imaging plates.

17. The printing apparatus defined in claim 16 wherein the apparatus has at least four print stations for imaging plates to print the colors cyan, magenta, yellow and black.

18. The printing apparatus defined in claim 16 wherein the apparatus has at least two print stations for imaging plates to print two densities of the same or two different colors.

19. The printing apparatus defined in claim 16 wherein at least one print station is configured to apply spot lacquer.

20. The printing apparatus defined in claim 17 and further comprising perfection means for reversing the orientation of the recording medium between print stations.

21. Printing apparatus comprising:

a. at least one print station, each print station including a print cylinder for supporting a printing plate, at least one discharge source for applying an image to the plate and means for moving each discharge source relative to the plate cylinder so that when the plate cylinder is rotated, the at least one discharge source scans a raster on the surface of the plate to produce an array of image dots;

b. means for rotating each cylinder;

c. ink-regulating means responsive to ink-control signals at each print station for regulating the amount of ink applied to the plate on the plate cylinder of that station; and
d. ink-control means for providing ink-control signals to said regulating means, said ink-control means counting the number of image dots to be formed by each print station on selected portions of said plate and controlling said ink regulating means at that station based on the number of dots to be printed by that print station on said selected plate portions.

22. The apparatus defined in claim 21 wherein the ink-regulating means at each print station include a plurality of electrically actuated ink regulators spaced across the apparatus for regulating the amounts of ink applied to different circumferential zones of the plate on the plate cylinder at that station, the setting of each ink regulator at each station being determined, at least in part, by the number of image dots to be printed in the corresponding zone of the printing plate at that printing station.

23. The apparatus defined in claim 22 and further including means for applying color-correction signals to said ink control means to change the ink control signals to said regulators so that the settings of said regulators may be offset from their positions determined by said image dot counts.

24. The printing apparatus defined in claim 21 wherein the apparatus has at least two said print stations for imaging plates.

25. The printing apparatus defined in claim 24 wherein the apparatus has at least four print stations for imaging plates to print the colors cyan, magenta, yellow and black.

26. The printing apparatus defined in claim 25 wherein the apparatus has at least two print stations for imaging plates to print two densities of the same or two different colors.

27. The printing apparatus defined in claim 24 wherein at least one print station is configured to apply spot lacquer.

28. The printing apparatus defined in claim 24 further comprising perfection means for inverting the recording medium between print stations.

29. The apparatus defined in claim 21 wherein each discharge source is a spark discharge electrode.

30. The apparatus defined in claim 21 wherein each discharge source is a plasma jet.

31. The apparatus defined in claim 21 wherein each discharge source is a laser.

32. The apparatus defined in claim 21 wherein each discharge source is a non-laser source of electromagnetic radiation.

33. The apparatus defined in claim 21 wherein each discharge source is an ink jet.

34. The apparatus defined in claim 21 further comprising means for sequentially transferring a recording medium among print stations.

35. Printing apparatus comprising:
    a. a plate cylinder;
    b. means for securing, to the plate cylinder, a printing plate having a printing surface and including a metal first layer and a second layer underlying said first layer, said first and second layers having different

affinities for a printing liquid selected from the group consisting of water and ink;

c. means for exposing the printing surface to spatial spark discharges between said plate and an electrode spaced close to said printing surface to remove said metal first layer and expose said second layer at said selected points on the plate;

d. means for moving the electrode and print cylinder relatively to effect a scan of the printing surface by the electrode; and

e. means for controlling the spark discharges in accordance with electronic signals representing an image so that they occur at selected times in the scan, thereby directly producing on the plate an array of image spots which can be inked to make copies of the document represented by the electronic signals.

36. The apparatus defined in claim 35 wherein the spark discharges carry current of at least 0.1 amp.

37. The apparatus defined in claim 35 wherein the potential of the spark discharges exceeds 2000 volts.

38. The apparatus defined in claim 37 wherein the potential is established by applying a positive voltage to the electrode relative to the plate.

39. The apparatus defined in claim 37 wherein the potential is established by applying a negative voltage to the electrode relative to the plate.

40. The apparatus defined in claim 35 wherein the potential of the spark discharge is sufficient to cause substantially straight-line travel of said spark from said electrode to said printing surface.

41. The apparatus defined in claim 35 and further comprising means for varying a characteristic selected from the group consisting of voltage, current, time duration and number of said spark discharges for varying the sizes of the spots produced by said discharges.

42. Printing apparatus comprising:

a. a plate cylinder;

b. means for securing, to the plate cylinder, a printing plate having a printing surface and including an oleophobic first layer, a metal second layer underlying said first layer and an oleophobic third layer underlying said second layer;

c. means for exposing the printing surface to spatial spark discharges between said plate and an electrode spaced close to said printing surface to remove said first and second layers and expose said third layer at said selected points on the plate;

d. means for moving the electrode and print cylinder relatively to effect a scan of the printing surface by the electrode, and

e. means for controlling the spark discharges in accordance with electronic signals representing an image so that they occur at selected times in the scan, thereby directly producing on the plate an array of image spots which can be inked to make copies of the document represented by the electronic signals.

43. The apparatus defined in claim 42 wherein the spark discharges carry current of at least 0.1 amp.

44. The apparatus defined in claim 42 wherein the potential of the spark discharges exceeds 2000 volts.

45. The apparatus defined in claim 44 wherein the potential is established by applying a positive voltage to the electrode

relative to the plate.

46. The apparatus defined in claim 44 wherein the potential is established by applying a negative voltage to the electrode relative to the plate.

47. The apparatus defined in claim 42 wherein the potential of the spark discharge is sufficient to cause substantially straight-line travel of said spark from said electrode to said printing surface.

48. The apparatus defined in claim 42 and further comprising means for varying a characteristic selected from the group consisting of voltage, current, time duration and number of said spark discharges for varying the sizes of the spots produced by said discharges.

49. Apparatus for imaging a lithographic plate, said apparatus comprising:

a. means for supporting a lithographic plate having a printing surface and including a metal layer and a second layer underlying said metal layer, said metal and second layers having different affinities for a printing liquid selected from the group consisting of water and ink;
b. at least one spark-discharge source, each of which includes a writing head comprising an electrode;
c. means for positioning the source close to the printing surface; and
d. means for delivering high-voltage pulses in excess of 2000 volts to each electrode to produce spark discharges substantially perpendicular to the printing surface without contacting the printing surface with the nozzle, said discharges being of sufficient strength to remove said metal layer and expose said second layer at the selected points, thereby changing

the affinity of said printing surface for said liquid at said points.

50. The apparatus defined in claim 49 wherein the spark discharges carry current of at least 0.1 amp.

51. The apparatus defined in claim 49 wherein the potential is established by applying a positive voltage to the electrode relative to the plate.

52. The apparatus defined in claim 49 wherein the potential is established by applying a negative voltage to the electrode relative to the plate.

53. The apparatus defined in claim 49 wherein the potential of the spark discharge is sufficient to cause substantially straight-line travel of said spark from said electrode to said printing surface.

54. The apparatus defined in claim 49 and further comprising means for varying a characteristic selected from the group consisting of voltage, current, time duration and number of said spark discharges for varying the sizes of the spots produced by said discharges.

55. Apparatus for imaging a lithographic plate, said apparatus comprising:

a. means for supporting a lithographic plate having a printing surface and including an oleophobic first layer, a metal second layer underlying said first layer, and an oleophilic third layer underlying said second layer;
b. at least one spark-discharge source, each of which includes an electrode;
c. means for positioning the source close to the printing surface; and

d. means for delivering high-voltage pulses in excess of 2000 volts to each electrode to produce spark discharges substantially perpendicular to the printing surface without contacting the printing surface with the nozzle, said discharges being of sufficient strength to remove said first and second layers at the selected points, thereby exposing said third layer.

56. The apparatus defined in claim 55 wherein the spark discharges carry current of at least 0.1 amp.

57. The apparatus defined in claim 55 wherein the potential is established by applying a positive voltage to the electrode relative to the plate.

58. The apparatus defined in claim 55 wherein the potential is established by applying a negative voltage to the electrode relative to the plate.

59. The apparatus defined in claim 55 wherein the potential of the spark discharge is sufficient to cause substantially straight-line travel of said spark from said electrode to said printing surface.

60. The apparatus defined in claim 55 and further comprising means for varying a characteristic selected from the group consisting of voltage, current, time duration and number of said spark discharges for varying the sizes of the spots produced by said discharges.

61. A method of imaging on a press including a plate cylinder for supporting a printing plate, said plate having a printing surface and including a metal first layer and a second layer underlying said first layer, said first and second layers having different affinities for a printing liquid selected from the group consisting of water and ink, said method comprising

the steps of:

a. mounting said plate to the plate cylinder;
b. without contacting said printing surface, exposing the printing surface to spark discharges between said plate and an electrode spaced close to said printing surface at selected points thereon to remove said metal first layer and expose said second layer at the selected points on the plate;
c. moving the electrode and the print cylinder relatively to effect a scan of the printing surface by the electrode; and
d. controlling the spark discharge in accordance with electronic signals representing an image so that they occur at selected times in the scan, thereby directly producing on the plate an array of image spots which can be inked to make copies of the document represented by the electronic signals.

62. The method defined in claim 61 wherein the spark discharges carry current of at least 0.1 amp.

63. The method defined in claim 61 wherein the potential of the spark discharges exceeds 2000 volts.

64. The method defined in claim 63 wherein the potential is established by applying a positive voltage to the electrode relative to the plate.

65. The method defined in claim 63 wherein the potential is established by applying a negative voltage to the electrode relative to the plate.

66. The method defined in claim 61 wherein the potential of the spark discharge is sufficient to cause substantially straight-line travel of said spark from said electrode to said printing surface.

67. The method defined in claim 61 and further comprising the step of varying a characteristic selected from the group consisting of voltage, current, time duration and number of said spark discharges for varying the sizes of the spots produced by said discharges.

68. A method of imaging on a press including a plate cylinder, a printing plate on the cylinder of said plate having a printing surface and including an oleophobic first layer, a metal second layer underlying said first layer, and an oleophilic third layer underlying said second layer, said method comprising the steps of:

a. mounting said plate to the plate cylinder;
b. without contacting said printing surface, exposing the printing surface to spark discharges between said plate and an electrode spaced close to said printing surface at selected points thereon to remove said first and second layers and expose said third layer at the selected points on the plate;
c. moving the electrode and the print cylinder relatively to effect a scan of the printing surface by the electrode; and
d. controlling the spark discharge in accordance with electronic signals representing an image so that they occur at selected times in the scan, thereby directly producing on the plate an array of image spots which can be inked to make copies of the document represented by the electronic signals.

69. The method defined in claim 68 wherein the spark discharges carry current of at least 0.1 amp.

70. The method defined in claim 68 wherein the potential of the spark discharges exceeds 2000 volts.

71. The method defined in claim 70 wherein the potential is established by applying a positive voltage to the electrode relative to the plate.

72. The method defined in claim 71 wherein the potential is established by applying a negative voltage to the electrode relative to the plate.

73. The method defined in claim 68 wherein the potential of the spark discharge is sufficient to cause substantially straight-line travel of said spark from said electrode to said printing surface.

74. The method defined in claim 68 and further comprising the step of varying a characteristic selected from the group consisting of voltage, current, time duration and number of said spark discharges for varying the sizes of the spots produced by said discharges.

75. A method of imaging a printing plate having a printing surface and including a metal layer and a second layer underlying said metal layer, said metal and second layers having different affinities for a printing liquid selected from the group consisting of water and ink, said method comprising the steps of:

a. spacing from the printing surface at least one spark-discharge source, each of which includes a writing head comprising an electrode, each writing head being oriented opposite the printing surface; and

b. delivering high-voltage pulses in excess of 2000 volts to each electrode to produce spark discharges substantially perpendicular to the printing surface without contacting the printing surface with the writing head, said discharges being of sufficient strength to remove said metal layer and expose said second layer at the selected points, thereby changing

the affinity of said printing surface for said liquid at said points.

76. The method defined in claim 75 wherein the spark discharges carry current of at least 0.1 amp.

77. The method defined in claim 75 wherein the potential difference is established by applying a positive voltage to the electrode relative to the plate.

78. The method defined in claim 75 wherein the potential difference is established by applying a negative voltage to the electrode relative to the plate.

79. The method defined in claim 75 wherein the potential difference is sufficient to cause substantially straight-line travel of said spark discharge from said writing head to said printing surface.

80. The method defined in claim 75 and including the additional step of varying a characteristic selected from the group consisting of voltage, current, time duration and number of said plasma-jet discharges for varying the sizes of the spots produced by said discharges.

81. A method of imaging a printing plate having a printing surface and including an oleophobic first layer, a metal second layer underlying said first layer, and an oleophilic third layer underlying said second layer, said method comprising the steps of:

a. spacing from the printing surface at least one spark discharge source, each of which includes a writing head comprising an electrode, each writing head being oriented opposite the printing surface; and

b. delivering high-voltage pulses in excess of 2000 volts to each electrode to produce spark discharges

substantially perpendicular to the printing surface without contacting the printing surface with the writing head, said discharges being of sufficient strength to remove said first and second layers at the selected points, thereby exposing said third layer.

82. The method defined in claim 81 wherein the spark discharges carry current of at least 0.1 amp.

83. The method defined in claim 81 wherein the potential difference is established by applying a positive voltage to the electrode relative to the plate.

84. The method defined in claim 81 wherein the potential difference is established by applying a negative voltage to the electrode relative to the plate.

85. The method defined in claim 81 wherein the potential difference is sufficient to cause substantially straight-line travel of said spark discharge from said writing head to said printing surface.

86. The method defined in claim 81 and including the additional step of varying a characteristic selected from the group consisting of voltage, current, time duration and number of said plasma-jet discharges for varying the sizes of the spots produced by said discharges.